pitch dark night. The animal was first seen about 25 feet from the ground, amongst the outer foliage of an overhanging lateral branch of a large bloodwood *(Eucalyptus)* tree, and appeared to be feeding on blossom. In the torchlight it appeared white, and the thin tail was noted. When the light was shone on the animal it moved off slowly, crossed to a vertical limb and climbed as high as possible, to about 50 feet from the ground. The tail was wrapped around the thin limb at times while the animal was climbing. The tail was curled around a thin branch when the animal was shot and the body hung pendulously but the strong tail grip was not released, even in death. The fresh specimen was carefully searched for parasites but none were found.

Mr. Buller asked several old Worora independently for the native name and all knew it as "Illungalya." The old people stated that the animal lived deep in rocks during the day and came out at night to feed on the bloodwood flats. They said it left the rocks and climbed the nearest tree, and then crossed from tree to tree without coming to the ground. It always returned to its home in the rocks well before dawn.

The animal is apparently excessively rare at Wotjulum. Only the old aborigines had seen the species previously. Mr. Buller spent about a month in the area in June and July, 1954, but saw only this one, and although large monetary rewards were offered to the aborigines for another specimen, none was obtained. Mr. A. M. Douglas spent five weeks in the area in September and October, 1955, and also offered substantial rewards, but without result. He personally searched for many hours at night in every type of habitat and camped out often, but did not see the animal.

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A REVIEW OF THE GENUS *COXIELLA* SMITH, 1894, *SENSU LATO*

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A. E. Smith compared some Australian decollate euryhaline shells with the South African genus *Tomichia* Benson, 1851, but because of the differing structure of the opercula he erected a new genus, *Coxiella,* for them. It was unfortunate that Smith in his discussion confused at least three different shells, lumping them together under Menke's species *striatula.* The identity and separation of these will be discussed under individual species below. Species described by Iredale and the present author have

nullified Smith's basic characters of division, but his genus is accepted until an anatomical examination of the animal can prove its validity or otherwise. Although I do not consider the form of the operculum constitutes a sound generic character it does form a convenient basis on which to separate species and show their affinities. As such it is used in this paper and the species discussed fall into three groups: (a) *striatula, glauerti, striata* and *minima;* (b) *glabra* and *exposita;* and (c) *pyrrhostoma* and *molesta.*

Thiele (1929) places *Coxiella* in the family Hydrobiidae, subfamily Truncatellinae. Hydrobiidae has become the repository for a large number of genera each containing few species of fresh-, brackish-water or estuarine dwelling molluses many of which have not been studied in any detail. This is particularly so in the case of *Coxiella,* the animal of which has neither been described nor its radula formula recorded.

Hedley (1923) suggested that *Coxiella* was important as an indication of a thalassoid element in the Australian fauna, and Glauert and Feldtmann (1928) enlarged upon this and suggested that Western Australia was the dispersal centre for the genus. The present work tends to confirm this view as we now have 6 species peculiar to South-West Australia, two in the State of South Australia (of which one is an overlap from the West), and three species in south-eastern Australia and the islands of Bass Strait. This distribution is paralleled by the land-shell genus *Bothriembryon* of which many species are found in south-west Australia and a single species in Tasmania.

This paper takes the form of a check-list and discussion on the known Australian species. The bibliography of each species contains all the references known to the author at the time of writing. A description of each species is given and any known variations are discussed. All localities known to the author from literature or from specimens are recorded, with the author or collector (if known) in brackets after each place name.

Most of the Western Australian material mentioned is the property of the Western Australian Museum, and this review was undertaken at the request, in 1955, of Mr. L. Glauert, its Director. It is, therefore, appropriate that the resulting paper should appear in this volume. I would like to thank Mr. C. J. Gabriel, Melbourne, and Dr. D. McMichael, Australian Museum, Sydney, for the loan of specimens.

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Sub-family TRUNCATELLINAE

Genus *COXIELLA* Smith, 1894

Coxiella Smith, A. E., 1894, *Proc. Mal. Soc. Lond.*, 1: 98.

Blanfordia Cox J., 1868 (non Menke), *Mon. Austr. Land Shells:* 94.

Coxiella Iredale, T., 1943, *Aust. Zool.*, 10: 210.

Type species, *Truncatella striatula* Menke, 1843.

Australian truncatellid shells inhabiting saline lakes. Shell turretted, consisting of 5 or more whorls, but the adults usually decollate and the whorls reduced, in some cases, to as few as 2½. Operculum wholly paucispiral, centrally paucispiral with concentric outer rings, or wholly concentric.

COXIELLA STRIATULA (Menke, 1843)

Truncatella striatula Menke, C. T., 1843, *Moll. Nov. Holl. Spec.:* 9.

Coxiella striatula Smith, A. E., 1894 (in part), *Proc. Mal. Soc. Lond.*, 1: 98.

——— Smith, A. E., 1898 (in part), *Proc. Mal. Soc. Lond.*, 3: 75.

Coxiella striata Glauert, L., & F. R. Feldtmann, 1928 (non Reeve), *A.A.A.Sc., Perth*, 18: 285.

Coxiella striatula Cotton, B. C., 1942, *Trans. Roy. Soc. S. Aust.*, 66: 129.

——— Iredale, T., 1943, *Aust. Zool.*, 10: 210.

——— Cotton, B. C., 1952, *Journ. Roy. Soc. W. Aust.*, 36: 19.

Shell turretted, decollate; 5-5½ whorls, pale flesh-coloured, sculptured with fine concentric lirae, sutures distinct; mouth elliptical with a fine sub-reflexed lip, interior deep yellow; umbilicus a small chink which is almost closed in some specimens by the reflected columella. Operculum thin, horn-coloured, concentric.

Measurements: (Average), 10 mm. long, 4.5 mm. wide.

Localities: Lake Ursula (L. Glauert) and Lake Bagdad, Rottnest Island (L. Glauert, 1932), [designated type locality Iredale, 1943]; 3 miles W. of Moora (R. J. Cosk); Lake Coogee S. of Fremantle (D. L. Serventy, 1927); Lime Lake, Wagin (H. P. Woodward); Lake Clifton; Cranbrook (Troughton & Wright); lake near Kelmscott; Phillips River (K. G. Buller, 1952); lake, Nullarbor Plain (Miss Snowball); Lake Coyrecup, 15 miles E. of Katanning (C. R. Clegg, 1933); Lake Wheatfield, Esperance (E. H. Sedgwick, 1955); Lake Muir, 35 miles S.E. of Manjimup (E. H. Sedgwick, 1955); Lake Cooloongup (E. H. Sedgwick, 1938); Streaky Bay, S.A. (Cotton, 1942).

Cox (1864) mistakenly applied the name of this species to the common eastern Australian *Coxiella*. Later Smith (1894, 1898) confused the larger *C. pyrrhostoma* Cox with the original *striatula* and placed it in the latter's synonymy; however, a series of each show them to be quite distinct. As can be seen from the long list of localities *C. striatula* is a very common shell in the south-west

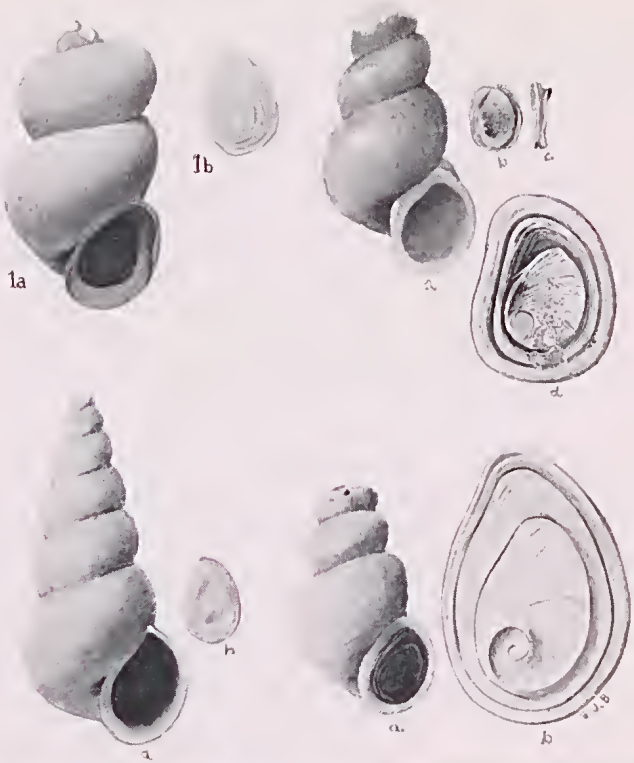

Fig. 1.—Upper left, *C. minima,* x 10 (1a, shell; 1b, operculum). Upper right, *C. glabra,* x 4½ (a, shell; b, operculum; c, inner edge of operculum showing lamellae; d, operculum greatly enlarged to show structure). Lower left, *C. striatula,* x 4½ (a, shell; b, operculum). Lower right, *C. exposita,* x 4½ (a, shell and operculum; b, operculum greatly enlarged to show structure).

of the continent and according to Cotton (1942) is found as far east as Streaky Bay, South Australia. Menke (1843) gave only the general locality "on sandy western coast, both recent and subfossil." Iredale (1943) designated Rottnest Island as the type locality and I think this should be further limited to "Lake Ursula, Rottnest Island."

COXIELLA GLAUERTI sp. nov.

Shell large for the genus, truncately fusiform, chalky white stained with yellow; spire tapering, decollate, sutures distinct; whorls 4-5 with a sloping shoulder forming a keel approximately 1-3rd of the distance from the suture, very distinct on the body whorl; keel becomes obsolete, due to erosion, on the upper whorls; body whorl roughened by longitudinal lines of growth, giving it an irregular wrinkled appearance; mouth oblique, elliptical; lip slightly reflected, white, and united by the white columella calus; interior bright orange red; umbilicus round, distinct, but partially covered by the expansion of the columella. Operculum thin, light

brown coloured, concentric with five or six lamellae forming a nucleus surrounded by a few more widely spaced layers.

Measurements of type: 13.7 mm. long, 6.5 mm. wide.

Locality: Israelite Bay (D. L. Serventy, 1948, Gabriel Coll.). Dr. Serventy collected live specimens on June 26, 1948, in a winding salt lake between mallee-covered sandhills just inland from the deserted settlement of Israelite Bay. There were none in the extensive salt lagoons by the shore.

This species superficially resembles *C. pyrrhostoma* but differs from it not only in its more rugose appearance but also in the fact that it possesses a concentric operculum.

Fig. 2.—Left, *C. glauerti*, x 4½ (a, shell; b, body whorl showing growth lines; c, operculum; d, enlargement of central area of operculum). Right, *C. pyrrhostoma*, x 4½ (a, shell; b, operculum; c, centre of operculum enlarged).

COXIELLA STRIATA (Reeve, 1842)

Truncatella filosa Sowerby, J. De C., 1838 *(nom. nudum)*, in Mitchell, *Three Expeditions to E. Aust.*, 2: 190.

Truncatella striata Reeve, L., 1842, *Conch. Syst.*, 2: 94; pl. 182, fig. 4.

Truncatella striata Catlow, A., and L. Reeve, 1945, *Conchologist Nomenclature:* 169.

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Blanfordia striatula Angas, G. F., 1864 (non Menke), *Proc. Zool. Soc.*, 1863: 523.

Blanfordia striatula Cox, J., 1864 (non Menke), *Cat. Aust. Land Shells:* 40.

———— Cox, J., 1868 (non Menke), *Mon. Aust. Land Shells:* 95; pl. 15, fig. 13, a, b, e.

Pomatiopsis striatula Ten.-Woods, J. E., 1876 (non Menke), *Proc. Roy. Soc. Tas.*, 1875: 78.

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Coxiella striatula Smith, A. E., 1894 (in part), *Proc. Mal. Soc. Lond.*, 1: 98.

Pomatiopsis striatula Mulder, 1896 (non Menke), *Geelong Naturalist*, 5 (4): 8.

Coxiella confusa Smith, A. E., 1898, *Proc. Mal. Soc.*, 3: 76.

Pomatiopsis striatula Lodder, M., 1900 (non Menke), *Proc. Roy. Soc. Tas.*, 1899: 138.

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Coxiella badgerensis Hedley, C., 1904 (non Johnston), *Proc. Linn. Soc. N.S.W.*, 29: 183.

Coxiella confusa Gatliff, J. H., 1905, *Vict. Nat.*, 22: 14.

Coxiella striatula Chapman, F., 1919 (in part), *Proc. Roy. Soc. Vict.*, 31: 25; pl. 3, fig. 3.

Coxiella filosa Hedley, C., 1923, *Vict. Nat.*, 50: 75.

———— Cotton, B. C., 1942, *Trans. Roy. Soc. S. Aust.*, 66: 129.

Coxiella striata Iredale, T., 1943, *Aust. Zool.*, 10: 210.

Shell truneately fusiform, rather smooth, not shining, eovered with a thin, dull, olivaeeous epidermis (under a lens the fine eoncentric lirae from whieh the species takes its name ean be clearly seen); spire tapering, deeollate, sutures distinct; whorls 3 or 4, gradually inereasing; aperture almost vertieal, elliptieal; mouth reddish-brown within, margin moderately thiekened, and expanded

Fig. 3.—Left, *C. striata*, x 4½ (a, shell and opereulum; b, opereulum enlarged to show strueture). Right, *C. molesta*, x 4½ (a, shell; b, opereulum; e, opereulum greatly enlarged to show strueture).

on the columella margin so that it partially covers the umbilical chink. Operculum black, thin, concentric.

Measurements (average): 7 mm. long, 4 mm. wide.

Localities: Mitre Lake, Vict. [type locality Iredale, 1943]; Scaholme, Vict. (M. Doery, 1948); Port Melbourne (J. H. Gatliff); Lake Corangamite, Vict. (J. H. Gatliff Coll.; F. A. Singleton, 1931; D. Le Souef, 1893; J. H. Weigall, 1950); Lake Reeve, Gippsland, Vict. (J. A. Kershaw); Lake Gnotuk, Vict. (J. A. Kershaw); swamp, St. Kilda, Vict. (W. Kershaw, 1865); St. Vincent Gulf, S. Aust.; Whitemark, Flinders Island, Bass Strait (P. B. Robins); Flinders Island, Bass Strait; Lake Bullenmerri, Vict. (G. B. Pritchard, C. J. Gabriel); Yorketown, S. Aust. (C. J. Gabriel Coll.); Frankston, Vict. (C. J. Gabriel); Belfast Lough, Port Fairy, Vict.

Dead and eroded specimens lose the olivaceous epidermis and become flesh-coloured with a dull lustre, but the concentric lirae remain visible unless specimens have been subjected to considerable sand blasting as is the case with material from Corangamite, Victoria. Some specimens from Flinders Island have retained the apical whorls and consist of 7 whorls of which the first 2 are paler in colour and lack concentric lirae. Shells from Lake Bullenmerri, the least salt of any lakes in which this species is known to occur, are larger than those from other localities. The largest Bullenmerri specimen measures 15 mm. long by 7 mm. wide and has 6 decollate whorls.

The very long list of references would suggest that this eastern Australian species has been investigated thoroughly; however, this is not so and there is very little published information on either the morphology or ecology of the species.

Reeve attached the name *T. striata* to a figure without description or locality but with the reference "Sowerby, J. D. C. Philosophical Magazine." Sowerby's reference cannot be found and apparently was never published. In 1952 in order to try to clear up the confusion I wrote to Dr. Rees, then Keeper of Molluscs at the British Museum of Natural History, about this matter. The following is his reply: "We have been unable to find an earlier description for *T. striata* Reeve so that the species obviously dates from 1842; it is now for you to decide whether Reeve's figure is adequate for the foundation of the species (here I would remind you that the type is not in the British Museum and presumably never was, and there is every reason to suppose that it is no longer in existence)." Although Reeve's figure is not an unmistakable representation of this eastern form, circumstantial evidence seems to suggest that it could be so, and as the name has been accepted in recent literature it will be less confusing to retain it. Iredale (1943) assumed that Reeve figured Mitchell's shell and designated Mitre Lake as the type locality.

COXIELLA BADGERENSIS (Johnston, 1879)

Pomatiopsis badgerensis Johnston, R. M., 1879, *Papers and Proc. Roy. Soc. Tas.*, 1878: 26.

Pomatiopsis badgerensis Johnston, R. M., 1888, *Geol. Tasm.:* 322, 329, 330.

Coxiella badgerensis Hedley, C., 1904, *Proc. Linn. Soc. N.S.W.,* 29: 183.

———— May, W. L., 1923, *Check-list Moll. Tasmania:* 57, No. 513.

———— May, W. L., 1923, *Illustrated Index. Tas. Moll.,* pl. 26, fig. 12.

———— Iredale, T., 1943, *Aust. Zool.,* 10: 211.

Johnston erected this species for shells in subrecent deposits on Badger Island, near Flinders Island, Bass Strait. His description is as follows:—Shell pyramidal, generally decollate, thin, scarcely opaque, pale fleshy white, inside tinted reddish brown; whorls, prior to being decollated, usually 7, subsequently average 5; decussate with irregularly raised lirae, and indistinct varices; suture deeply impressed, aperture roundly ovate, peristome continuous, margin somewhat thickened, inflated, and reflected; inner lip conspicuously reflected.

Measurements: 10 mm. long, 3.5-4 mm. wide.

Localities: Badger I., Bass Strait [type locality (Johnston)]; Sandfort, Tasmania (May).

Hedley and some later authors have placed this shell in the synonymy of *C. striata* but its much larger size and, if May's figure is correct, the spindle-like shape and indistinct varices, immediately separate it from that species. May, 1921, placed *Striatula* Cox in the synonymy of *badgerensis* but pointed out that Cox's species was not the same as that described by Menke. However, the shell he figured is of very different appearance from *striata* Reeve (=*striata* Cox) and the present author, like Iredale, is inclined to retain the species in the literature until further specimens are available to clear the point. I have not examined any authentic material.

COXIELLA MINIMA Macpherson, 1954

Coxiella minima Macpherson, J. H., 1954, *Aust. Geog. Soc. Report No. 1.* The Archipelago of the Recherche, 7: 56.

Shell small, 3-5 mm. high, truncate, smooth, dark horn-coloured, imperforate, 2½-3 whorls which are very rounded with deep sutures. Mouth oval, reflected, the inner lip showing a slight white callous. Operculum concentric, with centre slightly to the lower end; completely filling the aperture.

Measurement: 3.5 mm. long, 2.0 mm. wide.

Locality: Middle Island, Recherche Archipelago. Dr. D. L. Serventy, in a personal communication, states that this species must have been collected at the Pink Lake on Middle Island. On his two visits to the island (July 15, 1947, and June 20, 1948) he found its water intensely salt and containing little macroscopic life; no *Coxiella* were noticed.

This shell is distinguished from all other species by its small size and few whorls.

COXIELLA GLABRA sp. n.

Shell 2½ to 3 whorls, decollate, smooth, horn coloured faintly shining; with indistinct growth lines and faint concentric irregularity of the surface; whorls rounded with impressed sutures. Umbilical chink partly overlain by the reflected columella. Mouth almost circular, free, encircled by the strong reflected lip; interior pale orange. The operculum, horn-coloured, darker on the inner side, is peculiar in form as it combines a paucispiral and concentric structure; it consists of several lamellae of almost equal size with a distinctly smaller paucispiral plate superimposed on them. Two specimens of 3½ and 4½ whorls respectively appear to have retained all but the 1 or 2 embryonic whorls, but the majority of specimens like the type consist of only 2½ to 3 whorls.

Measurements of type: 7.0 mm. long, 3.5 mm. wide.

Localities: Morawa [type locality (S. R. White, 1949)]; lake near Three Springs (Dr. E. S. Simpson, 1936); Lake Neenan (Miss H. Spark, Dowerin, 1953); salt lakes near Coomberdale (H. Tonkin, 1939); Lake Ninan, Wongan Hills (E. H. Sedgwick, 1941).

This shell seems to be closely related to *Coxiella exposita* (Iredale) both in conformation and in the form of the opercelum. It differs in its lighter coloration and in the absence of concentric lirae.

COXIELLA EXPOSITA (Iredale, 1943)

Coxiellada exposita Iredale, T., 1943, *Aust. Zool.* 10: 211.

"Shell consisting of three rounded whorls, decollate, dark blackish brown, concentric striation, mouth oval, practically free, lip solid, three apical whorls sometimes present. The operculum was paucispiral but with age it appeared concentric through the increase being all round, instead of one side only, as in normal paucispiral opercula."

Measurements: 6 mm. long, 3.25 mm. wide; the largest about 8 mm. long. From amongst the paratypes (Iredale did not designate a holotype) I have selected for figuring as lectotype a specimen (Austr. Mus. No. C62210) that matches the measurements given in the original description.

Localities: Cranbrook, W. Australia [type locality (E. Le G. Troughton and J. H. Wright)]; Lake Parkeyerring, S. of Wagin (Dr. D. L. Serventy, 1954); lake 8 miles S.W. of Mogumber (Mrs. White, 1934).

This species seems to be closely related to *Coxiella glabra quod vid.* The present author considers that it lies within *Coxiella s.s.* rather than *Coxiellada.* It is distinguished from *C. striatula,* which it somewhat resembles, by its fewer whorls and concentric, paucispiral opercelum.

COXIELLA PYRRHOSTOMA (Cox, 1868)

Blanfordia pyrrhostoma Cox, J., 1868, *Mon. of Australian Land Shells:* 95; pl. 15, fig. 14.

Coxiella striatula Smith, A. E., 1894 (in part), *Proc. Mal. Soc. Lond.,* 1: 98.

——— Smith, A. E., 1898 (in part), *Proc. Mal. Soc. Lond*, 3: 75.

——— Glauert, L., and F. R. Feldtmann, 1928 (non Menke), *A.A.A.Sc., Perth*, 18: 285.

Coxiella pyrrhostoma Iredale, T., 1943, *Aust. Zool.*, 10: 210.

As can be seen from the above synonymy this species, though clearly defined by Cox, has been for some years confused with *Coxiella striatula* Menke, a distinct species of quite different form and having an almost completely separate range (see map).

Cox's very adequate description is as follows:—"Shell rimate, cylindrically tapering, decollated, obsoletely rib-striated, especially on the first whorl, and there decussated with fine spiral lines, dull white without lustre; spire very regularly tapering; whorls, at least six, uniformly slightly convex, last convex; aperture slightly oblique, its axis divergent from that of the shell, nearly elliptical; peristome white, inside of mouth bright red, enamelled, margins slightly joined by a callus, expanded, especially below and on columellar margin, leaving uncovered a minute umbilical fissure and aperture." Operculum is thin, pale horn-coloured and paucispiral.

Measurements of type: 17.5 mm. long, 7.5 mm. wide.

Localities: Salt Lake, Sharks Bay? [type locality (Cox); Bastow Coll., Gatliff Coll.]; Lake Grace (Head Teacher, 1951); Lake Cowcowing (H. Poole, 1944); Koorda (C. F. H. Jenkins, 1952); East Truslove (H. J. Teattle, 1913); 35 miles north of Esperance; 15 miles W. of Coorow (J. Reed, 1946); Lake Moore (G. S. Compton).

Cox gives the type locality as Sharks Bay, while in the Museum collection there are series labelled Salt Lake. North of Sharks Bay there is a large coastal lake bearing this name and it would seem likely that this is the type locality of the species; therefore a specimen from Salt Lake was selected for figuring.

The Salt Lake series contains specimens ranging in size from 3 mm. to 13 mm. in length. Even the smallest are decollate, finely concentrically striate, and show the characteristic flattened surface of the whorls and cylindrical taper which immediately distinguishes it from all other known species and confirms Iredale's opinion that it is separate from *Coxiella striatula* Menke. Specimens from the south-eastern sector of the State (Esperance) are identical in size and appearance with the Sharks Bay shells.

COXIELLA MOLESTA Iredale, 1943

Coxiella molesta Iredale, T., 1943, *Aust. Zool.*, 10. 211.

Shell olivaceous, eroding to flesh colour, long, narrow; texture shagreen with very faint longitudinal lines of growth; 6 to 10 whorls, flattened, mouth with reflected lip, not free, imperforate. Opercular, dark brown, paucispiral.

Measurements of type: 8 mm. long, 2.25 mm. wide. From amongst the paratypes (Iredale did not designate a holotype) I have selected for figuring as lectotype a specimen (Aust. Mus. No.

C.62207) that matches the measurements given in the original description.

Locality: Port Phillip, Victoria [type locality (B. R. Lucas)]. There is no indication of where in Port Phillip *C. molesta* was collected, and the only specimens in existence are the type series belonging to the Australian Museum.

This species is easily separated from all other members of the genus by its long slender appearance and shagreen texture.

Genus *COXIELLADDA* Iredale & Whitley, 1938

Coxielladda Iredale, T., and G. P. Whitley, 1938, *South Aust. Nat.*, 18: 66.

———— Cotton, B. C., 1942, *Trans. Roy. Soc. S. Aust.*, 66: 129.

———— Iredale, T., 1943, *Aust. Zool.*, 10: 211.

Type species, *Paludinella gilesi*, Angas, G. F., 1877.

Iredale and Whitley, in the course of a review of the Australian fluvifaunulae, stated the need for the separation of Angas's species *(gilesi)* from the remainder of the genus *Coxiella*, and proposed the above genus. In 1943 Iredale discussed and defined it in the following terms: "This genus should be transferred to the neighbourhood of *Gabbia*, even as Tate recognised. The shell is not truly deecollate, only the tip eroded, while the whorls are few in number, rounded, the shell perforate, the operculum paucispiral, with the nucleus subcentral, and increasing concentrically. The coloration is also different from that of the *Coxiella* series."

Iredale, as stated in the definition, would transfer this genus to the neighbourhood of *Gabbia* in the sub-family *Bithyniinae*. However, a comparison with the large series of *Coxiella* assembled for this paper has convinced the present author that it has sufficient features in common with that genus for it to remain in its vicinity until a detailed anatomical study of the animal can define its position.

COXIELLADDA GILESI (Angas, 1877)

Paludinella gilesi Angas, G. F., 1877, *Proc. Zool. Soc.:* 170, pl. 26, fig. 2.

Blanfordia stirlingi Tate, R., 1894, *Trans. Roy. Soc. S.A.*, 18: 196.

Blanfordia stirlingi var. *mammillata* Tate, R., 1894, *ibid.*

Blanfordia gilesi Tate, R., 1897, *ibid*, 21: 42.

Coxiella gilesi Smith, A. E., 1898, *Proc. Mal. Soc. Lond.*, 3: 7.

Coxielladda gilesi Cotton, B. C., 1942, *Trans. Roy. Soc. S. Aust.*, 66: 129.

Coxielladda gilesi Iredale, T., 1943, *Aust. Zool.*, 10: 211.

Coxielladda mammillata Iredale, T., 1943, *Aust. Zool.*, 10: 211.

Coxiella gilesi Ludbrooke, N. H., 1956, *Trans. Roy. Soc. S. Aust.*, 79: 41; pl. 1, fig. 1.

Angas's description of this species is as follows:—"Shell perforate, globosely turbinate, rather thin, pale orange, showing here

and there narrow, transverse, somewhat diaphanous lines of a dark colour, very finely longitudinally striated with the lines of growth; whorls 5, very convex, the last inflated; sutures impressed aperture subcircular; outer lip simple, arcuate; margins united by a broad, flattened, whitish callus, which is expanded over the columella and somewhat produced at the base. Operculum horny, paucispiral, with the nucleus subcentral."

Measurements of type: 8 mm. long, 5 mm. wide.

Localities: Lake Eyre, S. Aust. [type locality (Angas)]; Lake Callabonna [type locality *stirlingi* (Tate)]; Galena, Murchison River (D. L. Serventy, 1955); Peron Peninsula, Sharks Bay, W.A. (W. H. Butler, 1956); Lake Way, W.A. (Miss I. Dixon); Belele, W.A. (A. Snell, 1929); salt lake near Nannine, Murchison River, W.A. [type locality of variety *mammillata* Tate; C. J. Gabriel Coll.)].

Fig. 4.—*Coxiellada gilesi*, x 9 (a, shell; b, operculum).

Tate redescribed this species (as *stirlingi)* and a variety, *mammillata,* but later (1898) recognised that his species was identical with Angas's shell. In his description of the variety *mammillata* he stated that it differed from *stirlingi* in its smaller size, fewer whorls—5 instead of 6—darker coloration and mammilate form. A series from Belele seems to indicate that the variety is really the juvenile of the species. Young shells of 4 or 5 whorls are darker in colour with a fine epidermis, and as the whorls increase rapidly, the more eroded and therefore lighter coloured 1½ to 2 apical whorls appear mammillate. The Galena specimens are typical *gilesi* and are indistinguishable from Lake Eyre specimens. The single specimen from Nannine, in the Gabriel Collection, does differ in having the whorls more compressed than is usual for the species; therefore the apical whorls are more mammillate in appearance than in typical members of the species. However, this is a single aberrant individual amongst several hundred specimens from both Western Australia and South

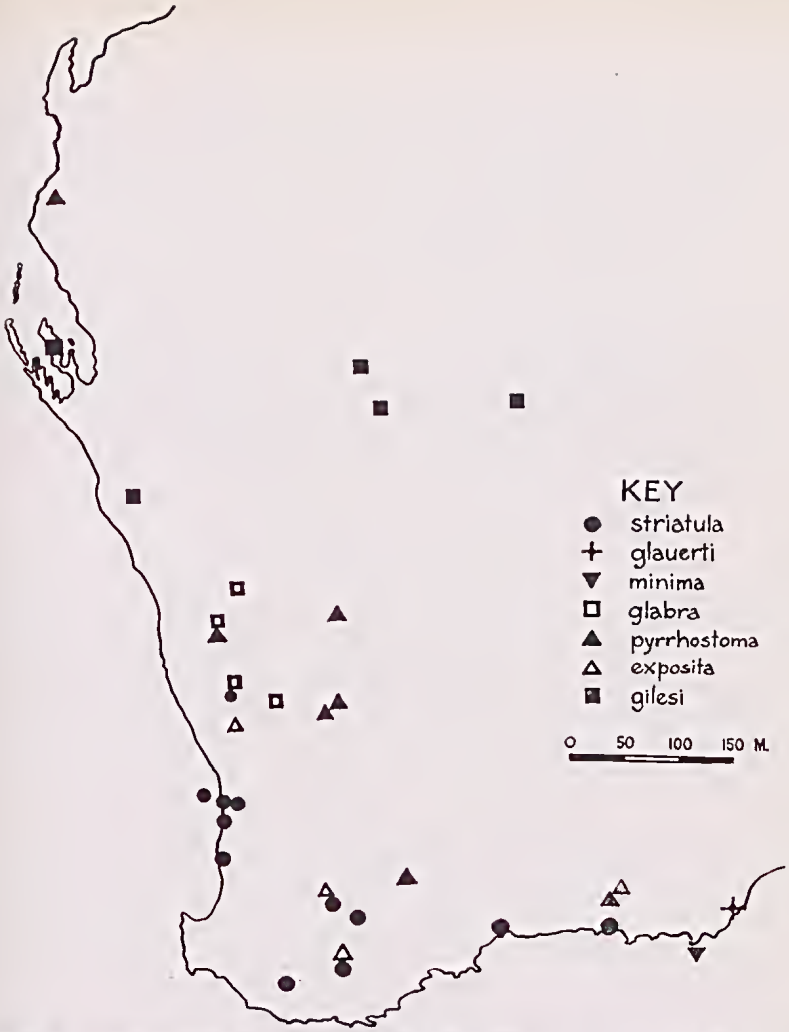

Fig. 5.—Distribution of *Coxiella* and *Coxielladda* species in Western Australia.

Australia, and I am not prepared to admit that this form is specific, as suggested by Iredale, or even a constant variety. It is simply an intraspecific variation. In all the material examined no other shell is quite as compressed as the Nannine specimen but there is considerable variation in the width to height ratio of specimens from one locality.

KEY TO SPECIES

1. Operculum concentric 4
2. Opercular paucispiral 7
3. Opercular concentric with a paucispiral centre 8
4. Adult shell decollate, retaining five or more whorls 5
   Adult shell decollate, usually retaining 4 or fewer whorls 6
5. Shell large chalky white, keeled below the sutures *C. glauerti*
   Shell medium, flesh-coloured, sculptured with fine concentric lirae ..... *C. striatula*

6. Opereulum black, shell eoneentrieally striated .... *C. striata*
Opereulum horn-eoloured, shell small, smooth .... *C. minima*

7. Shell horn-eoloured, not deeollate ..... *C. (Coxielladda) gilesi*
Shell ehalky white, deeollate .... *C. pyrrhostoma*
Shell olivaeeous, thin, deeollate .... *C. molesta*

8. Shell smooth .... *C. glabra*
Shell eoneentrieally striated .... *C. exposita*

A CONTRIBUTION TO THE LIFE HISTORY OF A HOVER FLY *MICRODON DIMORPHON* FERG., A DIPTEROUS INQUILINE

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On August 20, 1950, at Wanneroo, some larvae and pupae of *Microdon dimorphon* Ferg., a hover fly of the family Syrphidae (Diptera), were found in the nest of a small black ant, *Iridomyrmex chasei* Forel. Members of the genus have been reported as inquilines (Tillyard 1926, Donisthorpe 1927), but as far as I am aware this is the first record of the life history of this species from larva to adult. Egg-laying in the nest was not observed but adult flies have often been seen in the vicinity of the nests of these particular ants.

When found the larvae were very active, moving freely amongst the ants and in and out of the holes leading to the inner chambers of the nest. The ants tolerated the intruders and some were seen to touch and stroke the larvae with their antennae. These observations would seem to indicate that the larvae were true ants' guests, or at least tolerated scavengers.

The larva and puparium were almost alike in appearance; in fact in most cases the only discernible difference was in the lack of movement of the latter. Where pupation had taken place, the larvae had first cemented themselves to sticks or stones, in the roof or on the floor of the nest.

Larvae and pupae were placed in an observation case on August 21. The larvae at this stage were quite active, were on the move continuously, and seemed to prefer to move over the sticks and stones which had been placed in the case. It was noted that these stones were the main pupation spots chosen by the captives.

Pupation proceeded as follows. The larva would explore the selected piece of rock for several minutes, and after choosing a site would wriggle into position and then exude a pink liquid from its under surface. This would set like a cement and glue the animal into position. Approximately 8 hours after the cement had set, the outer surface of the larva had hardened, and the puparium appeared to be complete within 24 hours. At first there was little to distinguish the larva from the puparium, but after

36 hours the latter had turned a dark brown in contrast to the yellowish white of the larva. Soon after this stage two small rod-shaped tubercules appeared at the anterior end of the puparium. These are said to be used in pupal respiration and are not present in the larval stage.

Several of the pupae were dislodged after a few days, and in each case they exuded the pink cement from the ventral "sole." As soon as contact was made with a surface the puparium would be re-attached by the cement. The cement was very sticky and quick-drying.

The larvae commenced pupation on September 15 and adult flies were seen to emerge on September 25 and 28 and on October 7. Of 15 larvae placed in the case, 9 completed their metamorphosis.

Following on the successful rearing of the flies another batch of larvae and pupae was collected in 1955 from a different locality (Culham). They were taken from a common ants' nest, the inland variety of *Iridomyrmex chasei*. Their behaviour was similar to that of the Wanneroo specimens and they were apparently tolerated by the ants. In one nest 60 old puparia from a previous hatching were counted. From this same nest 35 pupae were selected for observation. There were very few larvae present at this stage (August 28), and it was concluded that most had pupated, and it seemed possible that the larvae seen would soon pupate. To test this supposition 6 of the larvae were collected.

The 35 pupae were placed in an observation case on August 29, and the 6 larvae were placed in a separate case on the same date. The larvae pupated on September 1. Unfortunately it was not possible to return to the nest at Culham to check if any larvae were left at that date.

The adult flies began emerging on September 1. It was noticed that as the time for emergence drew near the puparium lightened in colour and the outline of the fly could be seen through its wall. When the flies emerged their wings were bent and folded into small knob-like structures, which expanded into wings after 24 hours. In some flies the wings never developed beyond the "knob" stage, dampness due to overcrowding in the case possibly preventing their proper drying.

By September 21 most of the flies had emerged and many pairs were seen in copula. Of the specimens under observation, 25 completed their metamorphosis, and in 8 specimens the wings failed to develop beyond the "knob" stage.

I wish to thank Dr. S. J. Paramonov, of the C.S.I.R.O. Division of Entomology, Canberra, for identification of the adult flies.

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